

Black-Box Pedagogy Supports Mechanistic Reasoning & Epistemic Cognition

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The Black-Box Pedagogy

- I. Students are introduced to a phenomenon.
- II. The “black box” is explicitly identified.
- III. Students explore underlying mechanisms.
- IV. Students identify:
 - a. New mechanistic understanding.
 - b. Mechanistic gaps: explanatory black boxes.
- V. Stages III-IV are repeated iteratively.

Results

Mechanistic Reasoning

1. Increase in students’ mechanistic questions & explanations.
2. Students identify previously undiscussed explanatory black boxes.
3. Students discuss mechanisms across several scalar levels.

Epistemic Cognition

4. Students discuss and justify unpacking and black boxing.
5. Students’ justifications lean mainly on epistemic criteria, such as explanation scope and depth.

What is an Explanatory Black Box?

A causal statement in a mechanistic explanation that hides an underlying mechanism.

The Paradox: Unpacking an explanatory black box reveals new ones. Epistemic cognition is therefore needed to judge when and how to unpack.

Example

Smoking **causes** cancer

How does smoking **cause** cancer?

Benzo[a]pyrene in cigarettes **damages** DNA.

How does **benzo[a]pyrene** damage DNA?

